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A MULE AND A HORSE AS TWINS, AND THE INHERITANCE OF TWINNING . . . . . *W. R. B. Robertson.*

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A Mule and a Horse as Twins, and the Inheritance of Twinning.

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THIS occurred on the farm of George E. Loy, of Barnard, Kan., June 9, 1913. On hearing of the case, in March, 1916, I looked it up and found, from the testimony of Mr. Loy and his family and neighbors, and that of the photographers who took the pictures and from my own observation, that the following are the facts concerned.

In 1912, the dam (III_9), just ten minutes before being bred to the ass stallion (III_7), had been bred to a young three-year-old horse stallion (III_6), which was being used as a part of the technique sometimes thought to be necessary in securing the fecundation of the female horse by the male ass. In such cases fertilization is expected from the second sire. In this instance, however, there resulted twins, one of which was a male horse, the other a female mule.

The case in itself was of sufficient interest, fortunately, to be photographed at the time by the local photographer, who sold the pictures (fig. 1) at fifteen cents apiece. Photographs were also taken later by the district school teacher (figs. 2, 3 and 5). Photographs 4 and 6 were taken by myself. Unfortunately, the mare (III_9) had died of old age during the wintertime preceding my visit, and the horse foal (IV_{10}) had died of exposure and poor feed the winter of 1914-'15 at eighteen months of age. But in spite of these discouragements, the data given by Mr. Loy and his children and by his neighbors checked up in every way so well with the evidence afforded by the photographers, and with what I have been able to observe myself, that it seems worth while to put the case on record.

On investigating the history of the mare I found that in the nine times she had produced foals she had given birth to twins (mules) on two other occasions, the fifth and ninth times (see plate I). In addition, her second foal (IV_3) had given birth to twins (horses), and also her own half sister (III_{10}) had produced twins, though the latter came too soon, being "slipped" at nine months gestation. Evidently there must have been present in the family the trait of twinning handed down from mother to daughter, and through three generations, starting with the Oregon "herd" mare.

That this twinning is of the dizygotic sort is proven by the differing colors and markings in all of the cases, and in two cases by differing sexes. In the first pair (IV_6 and IV_7) both were males; but one was black, the other brown. The black one lived only two days. In the second case occurred the mule and horse pair (IV_{10} and IV_{11}), which certainly must have been dizygotic. They differed in sex and in marking, though both were bay, but one a light bay (mule), the other darker bay (horse). In marking, the mule had a small crescent-like white blaze to the right of the center of the forehead (fig. 4). The horse was of uniform bay color with black mane, tail and feet.

In the third case (IV_{12} and IV_{13}) the twins were mules of different sex and marked differently, the female (IV_{13}, figs. 5 and 6) having a white spot in the forehead and in general color darker, with less of the light tan color characteristic of mules about the muzzle and under-barrel parts, while the male had no white markings, was generally lighter in color, and had, as the photos will show, more of the light tan color about the muzzle and ventral parts.

In the fourth case (IV_{14} and IV_{15}), in which twins were produced by a half sister (III_{10}) of the mare III_9, the foals were aborted at between 8 and 9 months gestation. The sexes, colors, etc., were not recorded.

The fifth case (V_1 and V_2 was a pair of horse twins, both of the same sex but differing in color and markings, from the daughter (IV_3) of III_9. They did not live to maturity. One was a solid bay like the mother IV_3 and her sire III_1, while the other was sorrel with a "bald" white face and white feet, similar to the grand dam III_9 and the great grand dam (Oregon mare) II_4, and also to IV_1 (figs. 3 and 4), a full brother to the dam IV_3.

As the pedigree (plate I) will show, the mare was heterozygous for the presence of the bay factor, since her sire was black and her dam had the bay variation of chestnut, known (Castle's "Genetics and Eugenics") as sorrel. This probably gave her the ability to throw the black and brown coats of her first twin mules (IV_6 and IV_7) and also probably the darker and lighter brown coats of her third twin mules (IV_{12} and IV_{13}). That she carried the bay factor is certain from the fact that by a black horse stallion (III_6) she produced a solid bay colt (IV_{10}). Her daughter was probably heterozygous for black, which gave her, when bred to a sorrel sire (IV_2), the ability to throw in her twins one a sorrel, the other a bay like herself. This daughter must likewise have been heterozygous for spotting, *i. e.*, assuming spotting recessive. She herself was solid bay, but her mother (III_9) had white face and white points and one of her twin colts was similarly marked. These foals did not live to maturity.

By way of summary, these facts, then, show that in all probability each case of twinning in this family is one of the dizygotic type, due to the simultaneous, or nearly so, fertilization of two distinctly separate unlike ova by two unlike spermatoza. Of the four cases where observations were made, this is shown in two by differing sexes and at the same time differing general coat color and widely differing markings; in the two remaining cases by differing general coat color, black and sorrel or black and brown, and at the same time differing spotting with white. In addition, one of the former cases, where the sex of the pair is different, one foal is a mule and the other a horse.

A second conclusion is that in these cases we have evidence of the inheritance of the tendency to produce heterologous twins through three generations, transmitted evidently from the bald-faced sorrel Oregon mare (II_4), since two of her daughters (III_9 and III_{10}), by different sires, possessed the trait.

Likewise, it is probably to be concluded that in order to be the producer of such twins, the dam herself need not have been a twin, since neither III_9, III_{10} nor IV_3, all of which produced twins, were themselves twins. It must not be forgotten, however, that possibly the twin in each of these may have been formed but failed to develop.

In the case of the mule and horse twins, it might be supposed that the presence of a mule fœtus might in some way affect the development of a horse fœtus, and accordingly some abnormal characters appear in the horse (Lillie, '17). So far as I can see, no such characters are present. From the photographs that were taken (figs. 1-3), one can not detect mule characters. In figure 3 the hair is long, due likely to winter conditions. The photos of the mule show it likewise to be a normal animal.

The present occurrence of a mule and a horse as twins is probably what might be termed a case of superfecundation rather than superfœtation, since fertilization of both eggs could have taken place only at one period of heat. We have reason to think this from the fact that only one breeding to each sire occurred, and these breedings at a ten-minute interval. Mumford, in his text "The Breeding of Animals," gives seven examples of what he terms superfœtation. Six of these resulted in twin colts, one of which was a mule, the other a horse; but they resulted from fecundation at a second or later period of heat. One of the colts, accordingly, was usually smaller or less well developed than the other. In two of these cases both died at birth or soon after; in one case he does not say; in two cases one twin only died; while in one case (his plate II) both evidently lived. From the number of cases cited by Mumford, it may be seen that the occurrence of mule and horse twins is not such a rare phenomenon as one might expect. The facts in the case here presented and in the other cases probably indicate that such twins may be produced, not only by fertilization during pregnancy at a recurring period of heat, as Mumford's cases seem to be, but also as a result of the appearance of two ova in the uterus at once.

Newman, in his book "The Biology of Twins," p. 95, says: "At the present time, I have no reliable evidence of twinning in horses, but it is highly probable that this group offers no exception to the general rule that all mammals normally producing but a single offspring at a birth may have twins." The present case and those of Mumford, I believe, are now good evidence of twinning in the horse, and twinning in the case here described is shown to be of a hereditary nature.

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EXPLANATION OF PLATES.

PLATE I.

I_1. Black percheron stallion.

I_2. Black mare.

I_3. Full blood Arabian stallion; spotted over hips.

I_4. Wild pony mare from herd; color was black with large white spots.

II_1. McDuff, a black percheron stallion. Service charges, $25.

II_2. Black mare.

II_3. Arabian stallion; white, with some black spots.

II_4. Oregon mare, branded; color, sorrel; had white points from knees and hocks down, and a blaze in face.

III_1. Horse stallion; dark bay.

III_2. Ass stallion.

III_3. Ass stallion; black.

III_4. Ass stallion.

III_5. Ass stallion.

III_6. Horse stallion; black. Not related to III_9. Used to tease before breeding to ass stallion. Was two years old, coming three, at the time.

III_7. Ass stallion, "Mammoth" breed; gray. Owned by farmer W. T. Watson of Barnard, Kan. Used ten minutes after III_6.

III_8. Ass stallion.

III_9. Sorrel mare with white face and white points. (See figures 1, 2 and 3.) Face spot slightly to right. Foaled 1892. Mother of the mule twins, IV_6, IV_7; the horse-mule twins, IV_{10}, IV_{11}; and IV_{12}, IV_{13}. Died winter of 1915-'16.

III_{10}. Half sister to III_9, dam of twins IV_{14} and IV_{15}. Was owned by Mr. Loy's mother.

III_{11}. Horse stallion.

IV_1. Horse (gelding), sorrel. Foaled 1899. Markings and color (see fig. 4) same as mother III_9.

IV_2. Horse stallion; sorrel.

IV_3. Mare; solid bay. Foaled 1901. Mother of twins V_1 and V_2.

IV_4. Horse (gelding); solid bay. Foaled 1902.

IV_5. Mule (male).

IV_6, IV_7. Pair of male mule twins; one black, one brown. Black one died 48 hours after birth. "Its bowels did n't work. Veterinary gave it oil; then it scoured to death."

IV_8. Mule (female).

IV_9. Mule (female).

IV_{10}. Horse (male); bay with no spotting. (See figs. 1, 2 and 3.) Twin to mule IV_{11}. Normal. Lived into the second year, probably eighteen months. "Died of natural causes; poor feed and exposure in second winter (1914-'15."

IV_{11}. Mule (female). Twin to horse IV_{10}. Solid light bay; slight blaze to right of center of face. Normal strong mule. (See figs. 1, 2 and 4.)

IV_{12}. Mule (male); bay or brown. Twin to IV_{13}. No blaze on forehead; slightly lighter in color, and with lighter muzzle and under parts than its twin mate. (See figs. 5 and 6.)

IV_{13}. Mule (female); bay or brown. Twin to IV_{12}. Blaze on forehead; general color slightly darker, and muzzle and underparts slightly darker than twin mate. (See figs. 5 and 6.)

IV_{14}, IV_{15}. Pair of horse twins. Sex unrecorded; foaled too soon ("slipped") by half sister to III_9, at between eight and nine months of gestation.

V_1. Horse (male). Twin to V_2. Sorrel with bald face and white points like grand dam III_9. Did not live to maturity.

V_2. Horse (male). Twin to V_1. Solid bay. Did not live to maturity.

PLATES II, III AND IV.

FIG. 1. Photograph of mare III_9 and her horse-and-mule twins (IV_{10} and IV_{11}) at three days after birth, taken by a local photographer. Persons photographed are sons of the owner.

FIG. 2. Photograph of mare III_9 and her horse-and-mule twins, taken by the local school teacher in winter of 1914-'15.

FIG. 3. Photograph of mare III_9 and the horse colt twin, taken at same time by same party at closer range.

FIG. 4. The mule twin IV_{11}, in harness at thirty months of age. The horse IV_1 is the first colt of the mare III_9. Photo by the author, March, 1916.

FIG. 5. Third pair of twins (mules), IV_{12} and IV_{13}, at five days of age. Taken summer of 1915.

FIG. 6. Same as fig. 5, but lateral view. Photo by author, March, 1916.

MULE AND HORSE AS TWINS.
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PLATE I.

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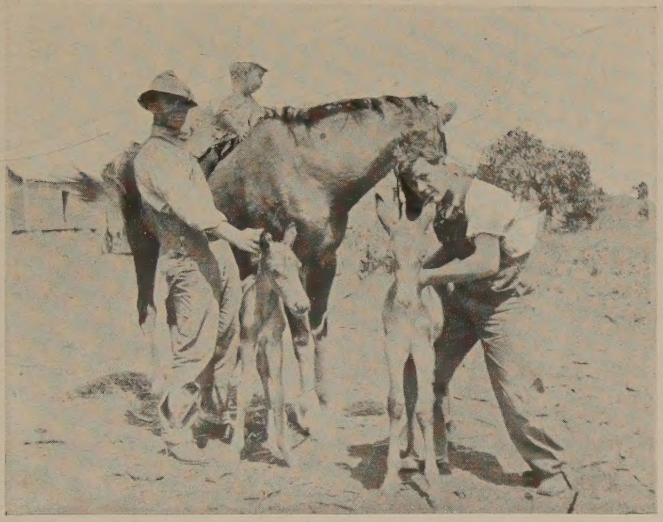
PLATE II.



III 9 & IV 10 & 11. Fig 1.

III 9 & IV 10 & 11. Fig 2

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PLATE III.

III$_9$ IX$_{10}$ Fig 3

IV$_{11}$ IV$_1$ Fig 4